A geographical simulation of impacts of Vientiane-Hanoi expressway

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A Geographical Simulation of Impacts of Vientiane-Hanoi Expressway

Souknilanh Keola*[1] and Satoru Kumagai*[2]

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Abstract

In this paper, we estimated the economic impacts of the proposed and some alternative routes of Vientiane-Hanoi Expressway (VHE), using a computational general equilibrium model based on spatial economics. The estimation results show that overall international positive impact depends more on whether it forms a cross-border expressway connection between the capitals of Vietnam and Thailand. The proximity of the expressway to Laos's capital is nevertheless critical to economic benefits expected within Laos.

Keywords: Simulation, New Economic Geography, Laos, Vietnam, Thailand
JEL classification: R12, R13, R42

*1 Research Fellow, Bangkok Research Center, IDE (souknilanh_keola@ide.go.jp)
*2 Director, Economic Geography Studies Group, Inter-disciplinary Studies Center, IDE (satoru_kumagai@ide.go.jp)

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INSTITUTE OF DEVELOPING ECONOMIES (IDE), JETRO
3-2-2, WAKABA, MIHAMA-KU, CHIBA-SHI
CHIBA 261-8545, JAPAN

A Geographical Simulation Analysis of Impacts of Vientiane-Hanoi Expressway

Souknilanh Keola and Satoru Kumagai

1. Introduction

The governments of Lao PDR (hereafter Laos) and Vietnam agreed in 2016 to move ahead with the project to construct the Vientiane-Hanoi Expressway (hereafter VHE) to link the capital of the two countries. Of the two routes initially proposed for the Lao section, i.e. (i) Vientiane capital–Xiengkhouang province–Houaphan province (approximately 600 km), and (ii) Vientiane capital–Bolikhamxay (approximately 450 km), the latter has currently been selected as the official candidate route of VHE. On the one hand, a preliminary study estimated that Laos's section of VHE would cost between 4 and 6 billion USD depending on the number of lanes. It needs to be noted that despite the name, most of the proposed expressways are within Laos's territory. Given the level of the external debt it faces, Laos will find it challenging to acquire the construction funds on its own. External involvement, especially by countries that would also benefit from the project, is essential if the project is to be realized in the foreseeable future. On the other hand, several national roads exist and have been functioning as the land route that links the two capitals and/or two countries. For instance, National Road No. 8 (NR8), which is the shortest and most used land route between the two capitals, was first built in the 1980s and upgraded in 2000s. Nevertheless, NR8 is mostly mountainous, and its quality is nowhere near that of the expressway. There is also National Road No. 12 (NR12), running through Khammouan province, that links Laos's capital with central Vietnam or links Thailand and Northern Vietnam via Laos. Meanwhile National Road No. 9 (NR9), Laos's section of the East-West Economic Corridor, is also used as a land route linking Southern Laos with Central Vietnam as well as Thailand and Central Vietnam via Laos.

This article has two aims. First, it uses the Geographical Simulation Model developed by the Institute of Developing Economies–Geographical Simulation Model (IDE–GSM) since 2007 to quantify the economic impacts on Laos and its neighbors both at the national and subnational levels and by industries. Second, it compares the impacts of the expressway construction of the current candidate VHE with the cost of upgrading some of the existing national roads into an expressway. The rest of this article is structured as follows. Section 2 summarises historical/theoretical backgrounds, basic structures, the baseline scenario, and the simulation procedure of IDE-GSM. Section 3 describes simulated scenarios. Section 4 discusses the results. Finally, Section 5 concludes with policy recommendations.

2. The IDE Geographical Simulation Model (IDE–GSM)

2.1. What is IDE–GSM?

Since 2007, IDE–Japan External Trade Organization (JETRO) has been developing IDE–GSM. The theoretical foundation of the IDE–GSM, co-developed with ERIA, follows 'New Economic Geography' (NEG), in particular, the work of Puga and Venables (1996) who capture the characteristics of multi-sector and country general equilibrium.

The IDE–GSM features agriculture, five manufacturing sectors (automotive, electric and electronics, textile and garment, food processing, and other manufacturing) and the services sector. The model allows workers to move within countries and between sectors. A notable difference between the IDE–GSM and Puga and Venables (1996) lies in the specification of the agricultural sector. The IDE–GSM explicitly incorporates land size in its production and keeps its technology as constant returns to scale.[1] The model's simulations incorporate the type of physical or institutional integration that will favorably or adversely affect regions of interest at the sub-national level. It also incorporates the impact of policy measures to facilitate international transactions on the magnitude and location of trade traffic. These steps enable us to identify potential bottlenecks and the way to reap the full benefits of economic integration. The basic structure of IDE–GSM is depicted in Figure 1. Each region possesses seven economic sectors (agriculture, five manufacturing sectors, and the services sector).

Figure 1. Basic Structure of the IDE–GSM Geographical Simulation Model

2.2. Base Line Scenario and Alternative Scenarios

We take into account the differences in gross regional product (GRP) between the baseline scenario and alternative scenarios (Figure 2) to calculate the economic impact of the development of various logistic infrastructures. The baseline scenario assumes national and subnational growth based on official statistics and international organization estimations made after 2010. The alternative scenario assumes that several forms of logistic infrastructure, mostly expressways, are completed in 2025. We compare the GRP between these two scenarios in 2030. If the GRP of a region under a specific scenario is higher (lower) than that of the baseline scenario, we regard this surplus (deficit) as a positive (negative) economic impact of the development of logistic infrastructure. It should be noted that the baseline scenarios assume about 6% growth at the national

[1] For further details of IDE-GSM, see Kumagai et al. (2015).

level. In other words, the negative impacts do not necessarily mean that the GRP of a region or an industry would actually shrink compared to its current size. It just means that they would be smaller than what they may have expanded to, i.e., the baseline. For example, suppose the result predicts that agriculture of region A would be -1% compared to the baseline in 2030. Moreover, suppose the baseline predicts that agriculture would expand from 50 to 100 (measured by whatever units) between 2025 and 2030. In that case, -1% of 50 being 0.2, the model predicts that agriculture would expand from 50 to 99.8 instead of 100 in 2030.

Figure 2. Image Diagram: Difference between the Baseline and Alternative Scenarios

3. Alternative Scenarios

We conduct a simulation analysis of the scenarios – S1 to S5 as described next. In addition to the expressway, we consider two ongoing projects, i.e., the Lao-Chinese High-speed Railway (HSR) project, which is under construction, and expected to be completed by 2022, and The Fifth Lao-Thai Friendship Bridge (B5) whose construction is expected to begin at the end of this year or early next year.

S1: The Lao-Chinese High-speed Railway is completed in 2022
Average train speed is set at 150 km/h

S2: The Officially-Proposed Route of the Vientiane-Hanoi Expressway is completed in 2025
The expressway from Bangkok to Nakhon Ratchasima is completed in 2022
The Fifth Lao-Thai Friendship Bridge (BR5) is completed in 2022
The average speed of expressway is set at 80 km/h

S3: S2 + The expressway from Nakhon Ratchasima is extended to Nong Khai (2025)

S4: S2 +
The upgrade of National Road No. 8 (NR8) to an expressway is completed in 2025
The construction of expressway to connect NR1 (Vietnam) to connect with NR8 (Laos) is completed in 2025
The construction of expressway to connect NR2 (Thailand) to connect with NR8 (Laos) is completed in 2025
The average speed of expressway is set at 80 km/h

S5: S2 +

The upgrade of National Road No. 12 (NR12) to an expressway is completed in 2025

The construction of expressway to connect NR1 (Vietnam) to connect with NR12 (Laos) is completed in 2025

The construction of expressway to connect NR2 (Thailand) to connect with NR12 (Laos) is completed in 2025

The average speed of expressway is set at 80 km/h

4. Results

4.1. By Countries

The overall impacts by scenarios, S1 to S5, and selected countries are shown in Figure 3. The upper part depicts the result in millions of USD, and the lower part in percentage.

S1 (HSR):

At the national level, Laos would gain the most both in terms of USD and percentage. HSR plans to operate cargo trains in addition to passenger trains. Our simulation which looks deeper into this particular project, in other paper, predicts that Thailand and China would gain more from the cargo train, given the current structure of Laos's economy that depends more on services. Nonetheless, when both passenger and cargo trains are operated, Laos would gain the most, followed closely by Thailand and China. In other words, although the scenarios setting is not the same, the conclusion does not change significantly. The annual gain in 2030 compared to the baseline is about 300 million USD for Laos followed by less than 200 million USD for Thailand, and about 100 million USD for China. The percentage difference of GDP for Laos is about 1% while it is negligible for Thailand and China given their relative economic sizes. This scenario does not consider restrictions coming from the number of daily passenger/goods trains in real operation, while the speed is set at 150 km/h or almost double that of the expressway. In reality, the number of daily passenger/goods trains in operation may be expected to affect the outcome significantly.

Figure 3. Impacts by Selected Countries

S2 (VHE without extension of Thailand's section):

When ongoing S1 is not taken into account, the gain from VHE is slightly smaller than that of S1. However, as earlier noted, this can be due to scenario setting which assumes a much higher train speed without setting any restriction on the number of trains operating per day. In USD terms, Laos gains nearly 200 million compared to the baseline in 2030, while Vietnam gains nearly 400 million and Thailand gains around 700 million USD annually. For Vietnam, in stark contrast to the

resulting impact of VHE, there would be almost no gain from HSR. The large gain in Thailand include those coming from the completion of under construction expressway from Bangkok to Nakhon Ratchasima.

S3 (VHE with extension of Thailand's section)

As far as VHE is concerned the gain for Laos's is the highest among studied scenarios with extension of Thailand's. Literally, VHE becomes a part of Bangkok-Hanoi expressway. The large gain in Thailand arises from the additional expressway, from Nakhon Ratchasima to Nong Khai, assumed to be constructed by scenario. As stated above, in addition to Laos's section, and from the border with Laos to National Road No. 1 in Vietnam, we assume that the expressway from Bangkok to Nong Khai in Thailand would be completed by 2025.

S4 (VHE NR8 Route):

In this scenario, the Laos section of VHE is assumed to be the NR8. We also assume Thailand and Vietnam would construct expressway to link NR8 with their nearest respective expressways. This is to ensure that we consider the impacts of alternative route of expressway in Laos properly. The VHE is obviously planned as a section of wider cross-border expressway. VHE would not be completed without connection to Hanoi. In addition, we have to assume that Thailand would do the same in order to compare the impacts with the official proposed route. For Laos the benefit of VHE decreases significantly to about 127 million USD from around 200 million in S3. The overall gain for Vietnam and Thailand are nevertheless almost unchanged.

S5 (VHE NR12 Route):

In this scenario the overall gain for Laos shrink substantially. It would still be a plus but with a very small one. However, the gain for Vietnam and Thailand slightly increase. The results up to this point yield two interesting insights. First, the location of the expressway does not affect the benefit to Vietnam and Thailand much as far as the link between Bangkok and Hanoi can be established. In other words, there is no change in benefit to Vietnam and Thailand whether Laos's section of VHE is the official candidate route or the NR8 or the NR12. The benefit for Laos, however, depends strongly on the distance from the expressway to its capital city.

4.2. By Countries and Industries

The overall and by-industry impacts by are shown by the tables in this section.

S1 (HSR):

Although S1 is a high-speed railway project between Laos and China, the overall impacts by countries is highest for Laos (318 million USD) in 2030 against the baseline, followed by Thailand, (146 million USD) and China (102 million USD). For Laos, 87% of the gain comes from growth in services, followed by apparel, food, and other manufacturing (Table 1). The food industry contributes the most to gain in Thailand, followed by apparel and automotive industries. The gain by industries for China resembles that of Thailand but on a smaller scale. The gain in other countries, including Laos's immediate neighbors are mostly minimal, i.e., less than 1 million USD annually. Notably, agriculture shrinks, compared to the baseline, for all selected countries except Myanmar. Again that this does not mean the size of agriculture in each country would literally shrink.

Table 1. Results of Scenario 1 (HSR) by Countries and Industries (Mil. USD)

S2 (VHE without extension of Thailand's section):

As mentioned above, the simulation result shows that the proposed expressway between Laos and Vietnam, without assuming expressway extension, other than those being constructed in Thailand, is expected to generate the most gain for Thailand (700 million USD) in 2030 against the baseline, followed by Vietnam (350 million USD) and Laos (196 million USD). Thailand is expected to gain in all industries, the largest gain being in services. Likewise Vietnam gains the most in services, followed by food industries. China gains in all industries except agriculture. Automotive industries are expected to expand in all selected countries although the magnitude is often smaller except for Thailand (Table 2).

Table 2. Results of Scenario 2 (VHE without extension of Thailand's section) by Countries and Industries (Mil. USD)

S3 (VHE with extension of Thailand's section): Thailand's gain is increases significantly when extension of Thailand's section is assumed (1 billion USD) in 2030 against the baseline. The overall gain for Laos and Vietnam remains more or less the same. Similar to previous scenario, Thailand is expected to gain in all industries, the largest gain being in services. However, the gain for China decreases to almost half of the official proposed route.

Table 3. Results of Scenario 3 (VHE with extension of Thailand's section) by Countries and Industries (Mil. USD)

S4 (VHE NR8 Route):

As stated above the gain for Laos decreases significantly for this scenario. The decrease arises largely in services. The impacts by industries for the rest of selected countries remain more or less the same.

Table 4. Results of Scenario 4 (VHE NR8 Route) by Countries and Industries (Mil. USD)

S5 (VHE NR12 Route):

The gain for Laos reduced to only about 5 million USD annually. The decrease arises largely in services. The impacts by industries for the rest of selected countries remain more or less the same.

4.3 By Sub-National Regions

A major benefit of IDE-GSM is that it can estimate impacts by sub-national regions. This section visually illustrates the simulation results of ongoing and highly-likely scenarios by sub-national regions in order to elaborate the regional perspectives of the impacts.

S2 (VHE without extension of Thailand's section):

First, Figure 4 shows the overall impacts. Sub-national regions along the expressway in Laos and Vietnam, but also in Thailand would gain the most. Nonetheless, a loss is observed for Thailand's North-western and lower Eastern regions. The positive impacts are observed to extend along the Eastern coast of Malaysia until Kuala Lumpur, although the rest of the country would suffer mild negative impacts. The positive impacts can also be observed in more distant regions in maritime ASEAN. Regions in Japan, the Korean peninsula, India and other South Asian countries would also be negatively impacted, when compared to the baseline scenario.

Figure 4. Overall Impacts of S2 (VHE without extension of Thailand's section) on Sub-National Regions in Selected Countries

S3 (VHE with extension of Thailand's section):

Figure 5 shows the overall impacts for VHE, assuming the extension of expressway to complete the expressway link between Bangkok and Hanoi. The gain is enhanced, especially for regions estimated to gain in the previous scenario. The loss in Thailand's North-western and lower Eastern regions persist.

Figure 5. Overall Impacts of S4 (VHE with extension of Thailand's section) on Sub-National Regions in Selected Countries

The rest of this section looks at the impacts by sub-national regions and by industries for S3, the officially proposed route of VHE, assuming the extension of Thailand's section, in other words, the most likely scenario. First, the impacts on agriculture are shown in Figure 6. The gain for agriculture is relatively small compared to overall impacts. However, positive impacts are observed in all except the North-western region, lower Eastern regions and the southernmost regions in Thailand. These areas in Thailand are known for currently exporting many types of fresh fruit to China through Laos and Vietnam. The result for agriculture seems to predict that it would be enhanced by both expressways and railways.

Figure 6. Impacts on Agriculture by Sub-National Regions in Selected Countries (S3)

Next is the automotive industry (Figure 7). China and Thailand have the largest agglomeration in the automotive industry. Vietnam is trying to foster the automotive industry. There has recently been some relocation of lower value-added portions of the automotive industry, particularly from Thailand, to latecomers such as Cambodia and Laos. The interesting point of the impacts on the automotive industry is that almost no region in any country is negatively affected. The positive impacts are predicted in all regions in ASEAN, India, China all the way to Japan. The regions around the capital cities of Laos, Vietnam and Thailand are expected to gain significantly more than the rural regions.

Figure 7. Impacts on Automotive Industry by Sub-National Regions in Selected Countries (S3)

The gain from electronics looks more encouraging for non-capital regions in the countries involved, especially Vietnam and Thailand (Figure 8). Except for the immediate vicinity of Ho Chi Minh City, all regions in Vietnam are expected to gain significantly. A region which is traditionally strong in the electronics industry in Thailand, such as the Chiang Mai area, is expected to gain substantially. China's coastal areas with already large agglomeration of this industry would also be positively impacted. In other words, the cross-border production network of the electric and electronics industry in this part of the world is predicted to jointly benefit.

Figure 8. Impacts on Electric and Electronic Industry by Sub-National Regions in Selected Countries (S3)

The apparel industry remains a major manufacturing industry for countries in the region. It is a kind of manufacturing industry that can relocate more easily to underdeveloped regions in developing countries. Our result shows that except for India, South Korea and Japan most sub-national regions would gain from the apparel industry (Figure 9).

Figure 9. Impacts on Apparel Industry by Sub-National Regions in Selected Countries (S3)

The gain in the food industry looks very promising for regions along the expressway in Laos and Thailand (Figure 10). Our results predict significant gain in Central and Northern Laos, and many regions, including EEC, in Thailand. Some mild negative impacts are predicted in Southern regions of Laos.

Figure 10. Impacts on Food Industry by Sub-National Regions in Selected Countries (S3)

Other manufacturing industries include high-tech industries such as aviation and bio-industries. The capital areas of Laos and Vietnam are expected to gain marginally from these industries (Figure 11). But areas around Ho Chi Minh City and Bangkok, costal area of China, all the way to South Korea and Japan are expected to gain from these high-tech industries.

Figure 11. Impacts on Other Manufacturing Industry by Sub-National Regions in Selected Countries

As shown in absolute terms above, Laos, Vietnam, and the countries involved would gain the most from services. Figure 12 illustrates a very strong location effect. In other words, positive impacts are predicted for regions not very far from the projects included in the scenarios, i.e., expressways and railway.

Figure 12. Impacts on Services by Sub-National Regions in Selected Countries (S3)

Finally, Figure 12 depicts the impacts of sub-national regions and industries for the mining industry. Our result predicts the gain from mining activities along the expressway in Laos.

Figure 12. Impacts on the Mining Industry by Sub-National Regions in Selected Countries

5. Conclusions and Policy Recommendations

We conducted simulation analysis to study the economic impacts of the proposed Vientiane-Hanoi Expressway, using IDE-GSM. In addition to the officially decided route, we examined some alternative routes that would use existing national roads in Laos. In general, we found that the expressway is expected to benefit the sub-national regions through which it passes. The scale of the benefit to the countries depends, however, on the distance of the expressway to/from its capital city. Vietnam and Thailand would have more or less the same benefit as long as they construct their own expressways to connect to that route, regardless of the route within Laos. However, the location of the expressway within Laos will profoundly determine the expected benefits to Laos. Finally, the region-wide benefit depends less on the construction of Laos's section and more on Vietnam's section and Thailand's section which would link two of the most prominent economic agglomeration cores of the lower Mekong region.

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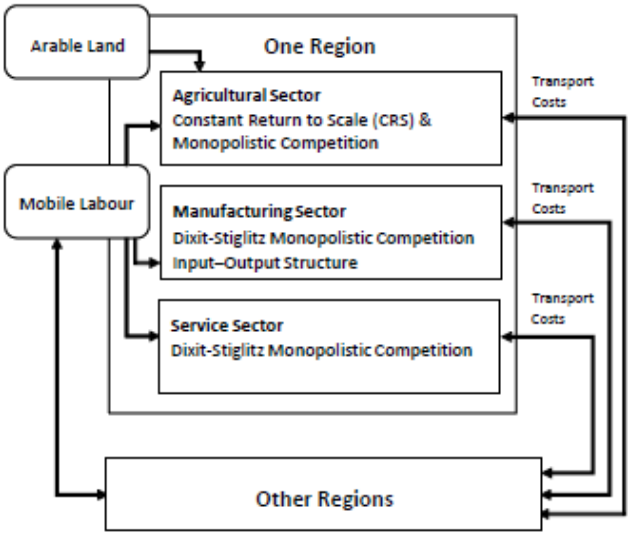
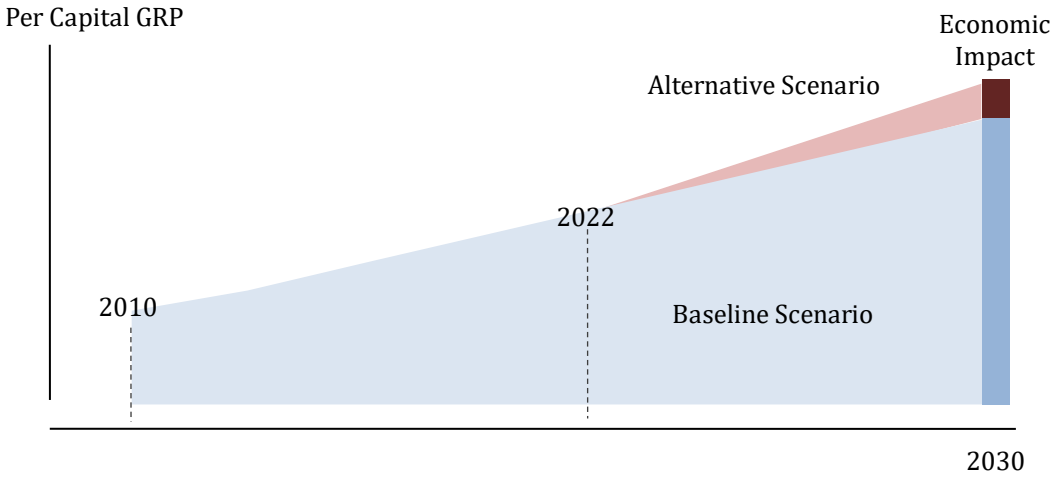
Figure 1. Basic Structure of the IDE–GSM Geographical Simulation Model



Source: IDE–GSM Team.

Figure 2. Image Diagram: Difference between the Baseline and Alternative Scenarios

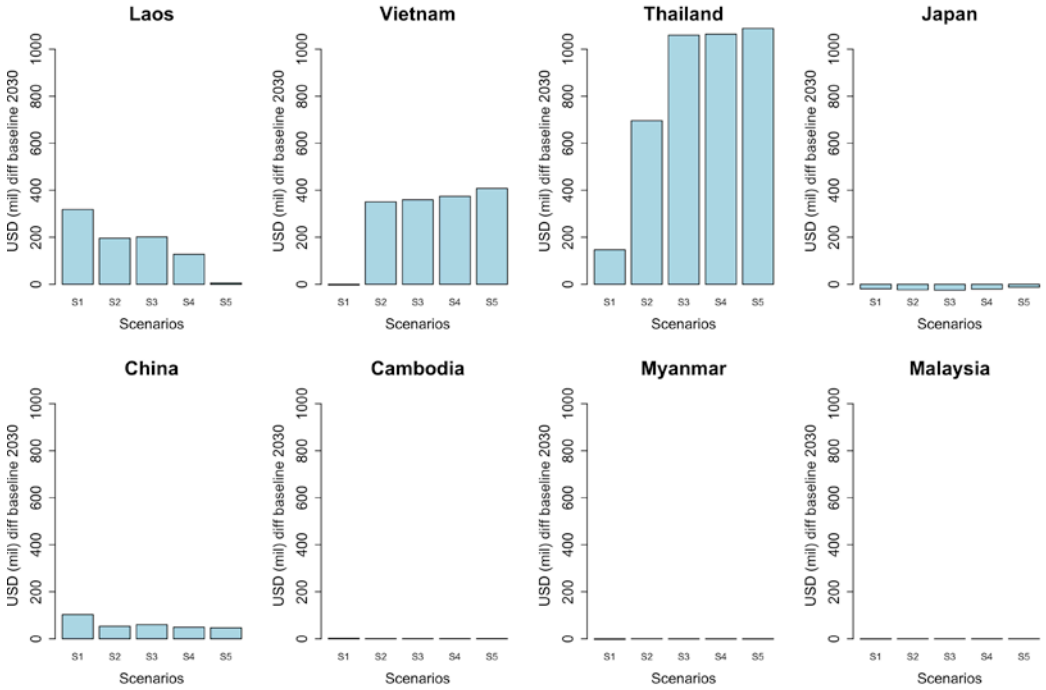


GRP = gross regional product.

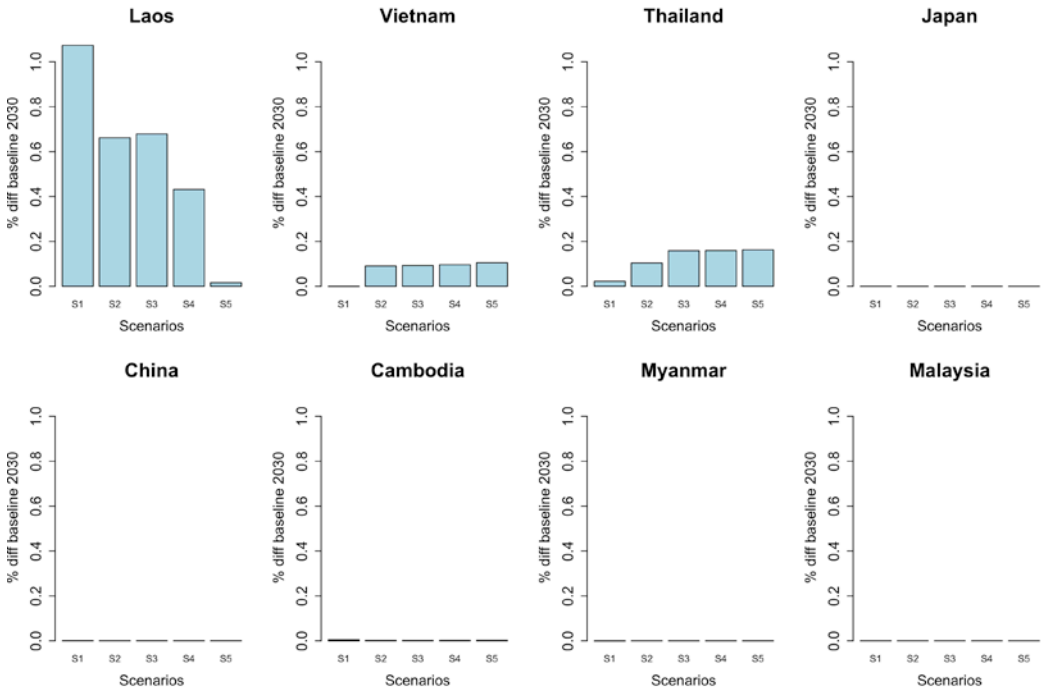
Source: IDE–GSM Team.

Figure 3. Impacts by Selected Countries

A: in USD



B: in %



Source: IDE–GSM Team.

Table 1. Results of Scenario 1 (HSR) by Countries and Industries (Mil. USD)

	Laos	Vietnam	Thailand	Japan	China	Cambodia	Myanmar
ALL	318.15	(2.65)	146.87	(19.03)	102.64	1.86	(2.12)
AGR	(0.53)	(0.05)	(0.39)	(0.12)	(0.59)	(0.01)	0.00
AUTO	0.67	(0.02)	32.25	(4.56)	11.21	0.01	(0.03)
E&E	(0.03)	0.01	(3.73)	(1.64)	(2.08)	0.00	0.00
APPL	21.38	(0.86)	57.33	(2.06)	22.52	2.02	(0.03)
FOOD	9.66	(1.77)	77.88	(4.29)	57.23	(0.01)	(2.12)
OTH	3.79	0.13	(9.04)	(2.36)	0.72	(0.02)	(0.05)
SER	277.29	0.31	(7.59)	(3.95)	(4.65)	(0.13)	0.11
MIN	5.93	(0.41)	0.16	(0.04)	18.27	0.00	0.00

Source: IDE–GSM Team.

Table 2. Results of Scenario 2 (VHE without extension of Thailand's section) by Countries and Industries (Mil. USD)

	Laos	Vietnam	Thailand	Japan	China	Cambodia	Myanmar
ALL	196.02	350.32	695.59	(23.61)	53.00	0.65	(0.39)
AGR	(0.60)	(0.21)	0.82	(0.28)	(0.31)	(0.03)	0.20
AUTO	0.15	1.01	24.67	0.68	2.18	0.00	0.00
E&E	0.17	5.19	18.73	(4.35)	9.94	0.00	0.00
APPL	12.49	9.60	20.66	(0.68)	4.93	0.92	0.00
FOOD	0.76	14.23	31.74	(2.52)	9.93	(0.02)	(1.01)
OTH	(1.36)	(0.72)	42.80	(3.75)	13.20	(0.04)	(0.11)
SER	183.43	321.14	556.18	(12.67)	8.10	(0.18)	0.54
MIN	0.98	0.08	0.00	(0.02)	5.03	0.00	0.00

Source: IDE–GSM Team.

Table 3. Results of Scenario 3 (VHE with extension of Thailand's section) by Countries and Industries (Mil. USD)

	Laos	Vietnam	Thailand	Japan	China	Cambodia	Myanmar
ALL	201.04	359.64	1,059.98	(25.18)	60.40	0.59	(0.86)
AGR	(0.43)	(0.11)	0.83	(0.08)	0.57	(0.02)	0.24
AUTO	0.19	1.04	26.96	2.86	4.31	0.00	0.00
E&E	0.28	5.51	20.57	(1.82)	16.63	0.00	0.00
APPL	12.17	9.20	23.04	(0.47)	10.55	0.96	0.00
FOOD	1.50	14.37	35.18	(1.61)	13.44	0.00	(0.57)
OTH	(0.88)	0.42	45.18	2.00	40.92	(0.02)	(0.05)
SER	187.23	329.07	908.21	(26.07)	(31.39)	(0.32)	(0.48)
MIN	0.99	0.14	0.01	0.00	5.37	0.00	0.00

Source: IDE–GSM Team.

Table 4. Results of Scenario 4 (VHE NR8 Route) by Countries and Industries (Mil. USD)

	Laos	Vietnam	Thailand	Japan	China	Cambodia	Myanmar
ALL	127.87	374.42	1,064.05	(20.31)	49.30	0.71	(0.91)
AGR	(0.40)	(0.10)	0.86	(0.04)	0.72	(0.02)	0.23
AUTO	0.26	1.00	25.71	3.10	3.24	0.00	0.00
E&E	0.17	6.00	21.01	(1.33)	16.31	0.00	0.00
APPL	9.55	9.77	19.55	(0.42)	9.67	1.06	0.00
FOOD	1.37	13.60	30.12	(1.30)	10.22	0.02	(0.57)
OTH	(1.40)	0.38	46.48	2.19	35.91	(0.02)	(0.05)
SER	118.13	343.81	920.26	(22.52)	(28.58)	(0.33)	(0.53)
MIN	0.19	(0.02)	0.06	0.02	1.81	0.00	0.00

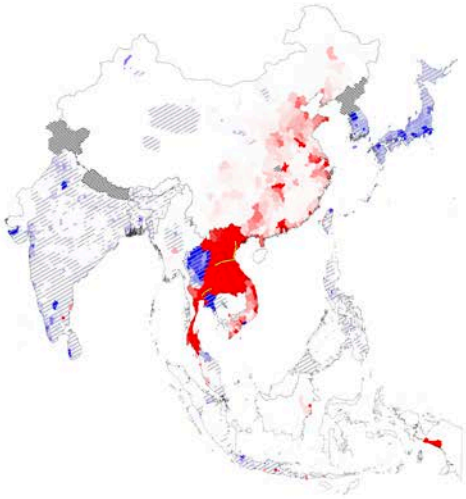
Source: IDE–GSM Team.

Table 5. Results of Scenario 5 (VHE NR12 Route) by Countries and Industries (Mil. USD)

	Laos	Vietnam	Thailand	Japan	China	Cambodia	Myanmar
ALL	4.79	408.08	1,088.03	(12.59)	46.98	0.84	(1.12)
AGR	(0.31)	(0.10)	0.91	0.03	0.93	(0.02)	0.22
AUTO	0.28	1.09	26.54	3.42	2.65	0.00	(0.01)
E&E	0.13	6.60	21.48	(0.46)	15.78	0.00	0.00
APPL	3.41	10.94	20.58	(0.58)	9.24	1.18	0.00
FOOD	0.85	14.97	31.23	(1.34)	9.48	0.03	(0.67)
OTH	(0.84)	1.34	47.27	2.98	28.88	(0.02)	(0.06)
SER	0.46	372.86	940.06	(16.66)	(24.55)	(0.33)	(0.61)
MIN	0.81	0.37	(0.03)	0.01	4.57	0.00	0.00

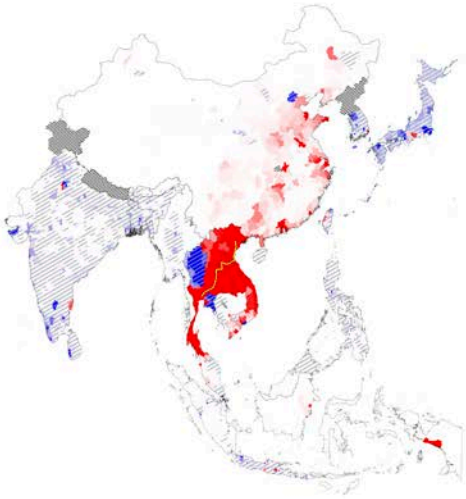
Source: IDE–GSM Team.

Figure 4. Overall Impacts of S2 (VHE without extension of Thailand's section) on Sub-National Regions in Selected Countries



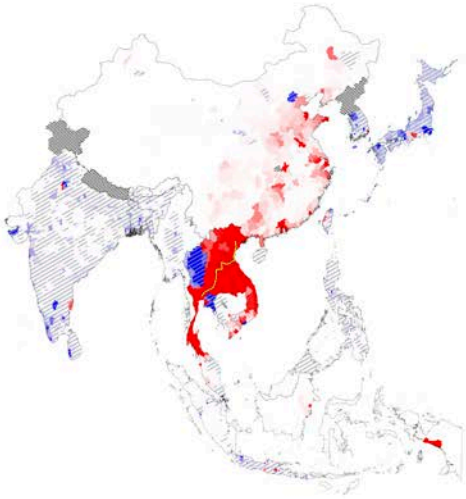
Source: IDE–GSM Team.

Figure 5. Overall Impacts of S4 (VHE with extension of Thailand's section) on Sub-National Regions in Selected Countries



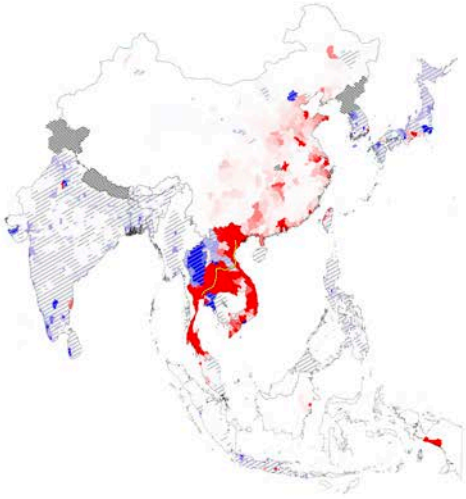
Source: IDE–GSM Team.

Figure 5. Overall Impacts of S4 (VHE NR8 Route) on Sub-National Regions in Selected Countries



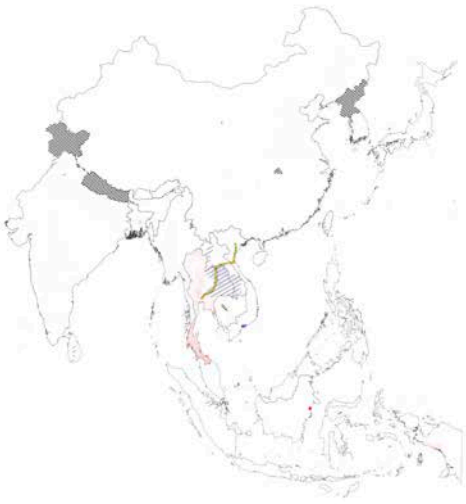
Source: IDE–GSM Team.

Figure 5. Overall Impacts of S5 (VHE NR12 Route) on Sub-National Regions in Selected Countries



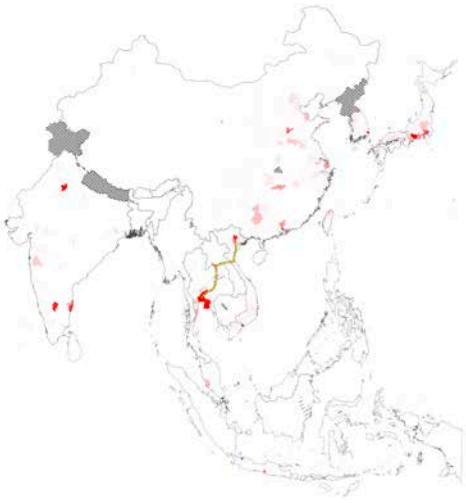
Source: IDE–GSM Team.

Figure 6. Impacts on Agriculture by Sub-National Regions in Selected Countries (S3)



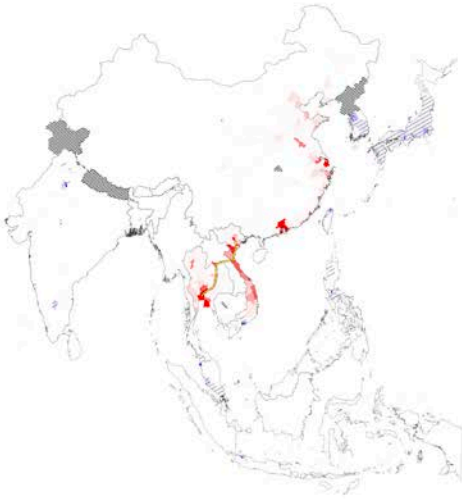
Source: IDE–GSM Team.

Figure 7. Impacts on Automotive Industry by Sub-National Regions in Selected Countries (S3)



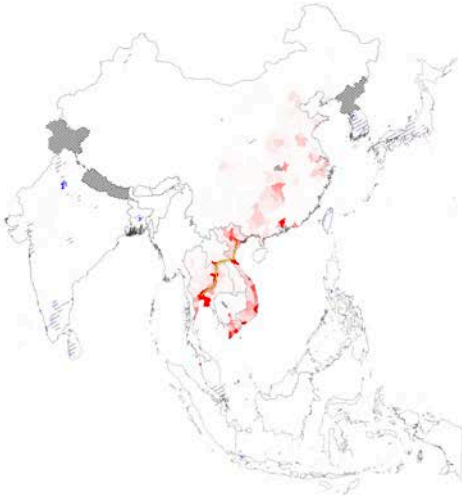
Source: IDE–GSM Team.

Figure 8. Impacts on Electric and Electronic Industry by Sub-National Regions in Selected Countries (S3)



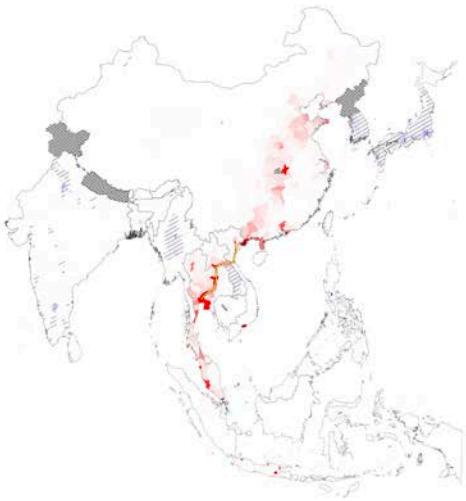
Source: IDE–GSM Team.

Figure 9. Impacts on Apparel Industry by Sub-National Regions in Selected Countries (S3)



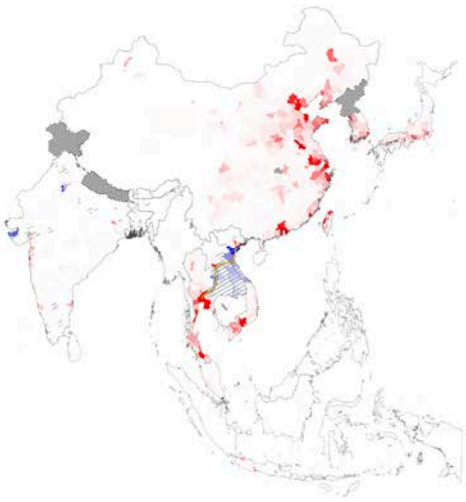
Source: IDE–GSM Team.

Figure 10. Impacts on Food Industry by Sub-National Regions in Selected Countries (S3)



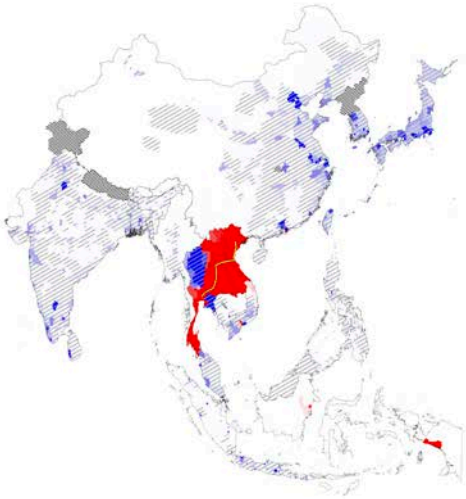
Source: IDE–GSM Team.

Figure 11. Impacts on Other Manufacturing Industry by Sub-National Regions in Selected Countries (S3)



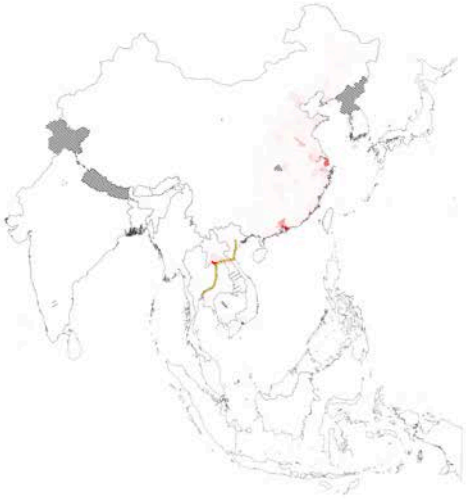
Source: IDE–GSM Team.

Figure 12. Impacts on Services by Sub-National Regions in Selected Countries (S3)



Source: IDE–GSM Team.

Figure 12. Impacts on Mining Industry by Sub-National Regions in Selected Countries (S3)



Source: IDE–GSM Team.